

Effects of a Core Stability Program on Strength and Balance Skills in Senior Over 65

Italo Sannicandro

Clinical and Experimental Medicine Department, University of Foggia, Italy
Master's Degree of Preventive and Adapted Physical Activity, University of Foggia, Italy

Abstract: *The strength core is an important prerequisite to perform sport skills and to perform some everyday activities such as walking, climbing stairs, postural control. The literature, so far, it is mainly dedicated to the description of the effectiveness of core stability exercises in athletes or in sedentary adults, with lumbar pain. The study describes the effects of a core stability training on balance and sit-to-stand skill in senior aged >65. In total 85 senior (44 female gender, 41 male gender, age 68.4 ± 1.6 yrs, height $114, 4 \pm 4.3$ cm weight 26.8 ± 2.7 kg) participated at the recreational motor activity study and were assigned to either an intervention core stability based (CSG, $n=43$, age 68.4 ± 1.6 yrs, height 168 ± 4.5 , weight 66.4 ± 1.8 kg) or a control group (CG, $n=42$, age 67.8 ± 1.6 yrs, height 169.3 ± 2.2 , weight 66.1 ± 4.5 kg). The training program has had a duration of 8 weeks (3 sessions/week, one hour); CSG, has integrated the activities in recreational form with 6 core stability exercises. The sample was evaluated by McGill Test, Chair Stand Test and Single leg stance test. The results revealed that the 8-week core stability training program improved the core stability test (sit-up position, +13.9%, $p<0.01$; right side +32.2%, $p<0.001$; left side +35.9%, $p<0.001$), balance performance (right limb +19.5%, $p<0.01$; left limb +19.7%, $p<0.01$) and strength ability, +13.3%, $p<0.05$. The study confirms the need to introduce integrative core stability exercise, as well as the literature suggests. The study highlights the transfer of core stability training on the balance and strength ability in senior aged >65.*

Keywords: core stability – senior - balance

1. Introduction

The relationship between sedentary lifestyles and related pathologies indicates a potential increase in cardiovascular and metabolic diseases, marked alteration in body composition and individual physical fitness (Kemi & Wisloff, 2010; Dimkpa, 2009; Ferrari, 2008; Bisciotti, 2006 & 2012), as well as limitations in daily activity (*Activity Daily Living* or *ADL*); such a decline appears more marked, whereas in advanced adulthood, the senior suspends or reduces motor skill levels (Bosquet et al., 2013).

Today the research analyzing the effects of different motor activity protocols on the senior and aims to understand which ones can allow adaptations with lower overload risks in >60 aged (Sannicandro et al., 2008; Sannicandro, 2013; Scurati et al., 2016; Rosa et al., 2016).

In recent years, new exercises have been introduced to reduce the lower-back pain risk and to improve postural control, including core stability exercises (Grancher et al., 2013; Grancher et al., 2011; Kahle & Tevald, 2014; Khang et al., 2012; Khang, 2015; Sannicandro, 2014).

Core is defined as that complex anatomic area formed by the lumbar spine, hip, hip joint, and all muscles acting, controlling or favoring the movements allowed by such articulations. The intrinsic nature of these muscle boundaries assigns to this district a significant role in spine and lumbar district stabilization (Hodges & Richardson, 1996, 1997 & 1999; Hodges, 2003; Hicks et al., 2005; Hodges et al., 2005; Panjabi, 1992; McGill, 2001), inducing some Authors to identify a local and global control system of muscles acting on this body segment, in relation to their recognized function (Bergmark, 1989; Panjabi, 1992; Mc Gill, 2001; McGill et al., 2003; Aluko et al., 2013; Crisco & Panjabi, 1991; Urquart & Hodges, 2005; Willson et al., 2005).

For ACSM, these types of exercises should systematically be part of the training sessions of all healthy adults,^{16, 32} in order to prevent any column and lower limbs lesions (Hodges & Richardson, 1997; Hicks et al., 2005; Hodges et al., 2005; Nourbakhsh & Arab, 2002; Arnold et al., 2015; Comerford & Mottram, 2001; Jemmet, 2003): ACSM's suggestions, in practice, support the effectiveness and systematic nature of this type of exercise in order to improve these functional relationships and to extend individual autonomy; other Authors point to it as effective content for the prevention of falls by increasing static and dynamic balance ability (Granacher et al., 2013; Kahle & Tevald, 2014; Kang, 2015).

2. Methodology

The aim of the study is to verify the effects of a core stability-based intervention program, compared to a single recreational activity program, on strength and balance skills in subjects over 65 years of age.

The study was conducted with active adults ($n = 85$, 41 males, 44 females) randomly divided into 2 groups: the core stability training group (CSG, $n = 33$, 68.4 ± 1.6 years, 66.4 ± 1.8 kg, 168 ± 4.5 cm) and the control group carrying out only recreational activities (CG, $n = 32$, 67.8 ± 2.8 years, 66.1 ± 4.5 kg, $169.3 \pm 2, 2$ cm).

All subjects have been informed in advance about proposed training and potential risk of injuries.

The following functional tests were used to evaluate motor capacity:

- McGill Test was used to evaluate the strength of the trunk using the three positions established by the protocol; The

Volume 6 Issue 8, August 2017

www.ijsr.net

Licensed Under Creative Commons Attribution CC BY

subject is encouraged to keep isometrically as long as possible the position of sit-up, lateral plank and trunk extension. It is detected the time at which the subject manages to hold the assigned positions (McGill 2001 & 2003).

- Chair Stand Test was presented to evaluate the strength of the lower limbs; the subject is invited to get up and sit as many times in the 30-second interval. It is detected records the number of repetitions performed (Rikli & Jones, 1999)
- Single Leg Stance test was presented for static equilibrium evaluation; The subject in unipedal support, with hands on chest and open eyes, is invited to maintain the assigned position by cautiously not tilting the torso, abducting the lower limb in suspension, or touching the ground. It is detected the time when the subject is able to keep the assigned position. The test was performed on both limbs (Springer et al., 2007).

For all the values obtained, the descriptive statistic (mean, standard deviation) was determined, while the mean comparison was performed by t-test for paired data for comparison of T0 and T1; a T-test for independent data was performed to verify the intergroup differences (CSG vs CG). Statistical significance was set at $p < 0.05$. To estimate the effect size index (EffectSize: ≤ 0.20 small, 0.50 mean, ≥ 0.80 large, Cohen, 1992) in T1, the Cohen's D was calculated.

3. Training procedures

The training period lasted 8 weeks (3 sessions/week) in which all subjects involved had 24 sessions of approximately 60 minutes each.

Before and after the training period (T0 and T1), there were established 2 evaluation sessions to assess motor skills and anthropometric variables.

The CSG has integrated the regular sessions of recreational motor activity with the following exercises:

- a) Plank: 3x6x6 sec.
- b) Side Plank: 3x4x6 sec. for side
- c) Prone Plank: 3x6x6 sec
- d) Climber: 4x6 reps
- e) Hip extension on the ground: 4x8reps
- f) Lower limb extension from quadruped position: 3x4xleg

4. Results

The CSG obtained significant differences in the pre-post comparison in the McGill test, in sit-up position ($p=0.003$), in left and right side plank position ($p=0.001$), in single leg stance test left limb ($p=0.003$) and right limb ($p=0.006$) and in Chair Stand Test ($p=0.04$).

The CG has not obtained significant differences in the pre-post comparison values assessment.

The values highlighted in T0 and T1 for the two monitored groups are summarized in the table 1.

Table 1: Values obtained in CSG and CG in T0 and in T1

Test	Core Stability Group			Control Group				
	T0 m±ds	T1 m±ds	P Value paired data	T0 m±ds	T1 m±ds	P value paired data	P value Independent data	D Cohen (ES)
McGill Test (sit-up)	14.2±3.3	16.5±2.7	0.003***	14.2±2.4	14.6±1.6	0.146	0.04	0.45
McGill Test (extension)	21.1±3.6	21.6±3	0.634	20.2±4	17.9±4.3	0.160	0.02	0.46
McGill Test (right side plank)	11.8±3.8	17.4±3.2	0.0001***	11.9±1.6	12.5±2.4	0.091	0.03	0.56
McGill Test (left side plank)	11.4±3.7	17.8±3.3	0.0001***	10.6±3.3	10.9±1.8	0.087	0.003	0.56
Single Leg Stance Test (right limb)	15.70±4.2	19.55±2.1	0.003**	15.65±3.8	15.37±3.1	0.204	0.003	0.68
Single Leg Stance Test (left limb)	15.91±2.8	19.88±2.8	0.006**	15.22±3.7	14.51±5.2	0.167	0.003	0.65
Chair Stand Test	9.81±2.3	11.3±1.3	0.04*	10.25±2.9	11.1±2.3	0.269	0.04	0.45

5. Discussion

The aim of this study was to compare the effects of a recreational physical fitness training, compared to an integrated training program with Core Stability content as well as core exercise, on senior subjects. In the present work, at the end of the eight-week training, from the comparison of pre- and post-test data, there were differences between CSG and CG in all assessed capacities.

Observing the values of the two groups at the T1, the CSG in the McGill Test used to verify the stability of the column revealed an increase of 13.9% in Sit-up position, 32.2% in the right side plank position, and an improvement of 35.9% in the left plank position, highlighting significant differences

over the CG, except for extension position test. The obtained values are consistent with what is present in the literature and obtained with a sample of similar subjects by age and gender, to which core stability 10 exercises (Rosa et al., 2016) have been proposed and superimposed on training studies conducted for higher time periods than those of this study who have made use of the same evaluation tests (Granacher et al., 2013).

The medium Effect Size indicates the significance of the differences between the average values obtained in the two evaluation periods.

The significant increase in almost all the McGill Test tasks in the CSG suggests that the proposed exercises have proved

to be functional to increase Core control, a goal that is considered to be a priority by the ACSM guidelines (ACSM, 2010; Javadian et al., 2015; Klizienè et al., 2015).

The introduction of Core stability exercises returned a positive transfer in the CSG on static equilibrium tests on both right and left limbs (+ 19.5 % for right limb and 19.7% for left limb) suggesting that trunk strength plays a significant role in unipedal control, as evidenced in the literature (Petersen & Nittinger, 2014; Ko et al., 2014; Suri et al., 2009).

To support this hypothesis, in the literature there are several researches and contributions that report significant results on the senior balance involved in fall prevention training programs and introduced Core stability exercise (Granacher et al., 2011 & 2013; Kang et al., 2012; Kang, 2015; Arnold et al. 2015; Ko et al., 2014; Suri et al., 2009).

In particular, two studies, always focused on specific trunk stabilization exercises, reported the same increases in static equilibrium ability obtained in the present study, using the same evaluation test (Seo et al., 2012; Pfeifer et al., 2001); such functional relationships seem to be maintained and highlighted even for older people up to 80 years age (Kahle & Tevald, 2014; Hosseini et al., 2012).

Significant gains from the CSG in the Chair Stand Test (+ 11.3%, ES: 0.45) compared to the increase obtained by CG (+ 7.7%, ns) induces as much as trunk strength influencing daily use movements (stand up and sitting) in the senior >65 aged: the values are overlapping with what has been achieved by other researches that have been using unstable tools to activate Core's muscles and have gained improvements in The Chair Stand Test (Seo et al., 2012; Pfeifer et al., 2001).

6. Conclusion

In conclusion, the results obtained confirm what is already described in the literature, that the senior also fits to loads targeted at the Core district with positive transfer and adaptation to strength ability (Sannicandro et al., 2008; Rosa et al., 2016; Seo et al., 2012; Katzman et al., 2007; Pfeifer et al., 2001; Faina et al., 2008) and balance (Granacher et al., 2011 & 2013; Kahle & Tevald, 2014; Kang, 2015; Arnold et al., 2015).

Hence, the values described allow to say that the core stability exercises can be introduced into senior fall prevention programs and to get positive transfer on strength and balance ability in >65 aged (Kasukawa et al., 2010; Sinaki et al., 2005; Petrofsky et al., 2005).

7. Future Scope

Future studies may investigate whether core stability programs can increase walking speed and endurance performances in over 65 aged senior

References

- [1] Aluko A., DeSouza L., Peacock J., *The effect of Core Stability exercises on variations in acceleration of trunk movement, pain, and disability during an episode of acute nonspecific low back pain: a pilot clinical trial*, J Manipulative Physiol Ther., 36:497-504. 2013
- [2] American College of Sports Medicine, *ACSM's Guidelines fo Exercise Testing and Prescription* (8th ed.), Thompson, WR, ed. Philadelphia, PA: Lippincott, Williams & Wilkins, 2010
- [3] Arnold C., Lanovaz J., Oates A., Craven B., Butcher S., *The Effect of Adding Core Stability Training to a Standard Balance Exercise Program on Sit to Stand Performance in Older Adults: A Pilot Study*, Journal of Aging and Physical Activity, 23:95-102. 2015
- [4] Bergmark A., *Stability of the lumbar spine. A study in mechanical engineering*, Acta Orthopaedica Scand, 230:20-24, 1989
- [5] Bisciotti G.N., *Attività fisica ed osteoporosi*, New Athletic Research in Science Sport, 195:21-28. 2006
- [6] Bisciotti G.N., *L'invecchiamento*, Calzetti-Mariucci, Perugia. 2012
- [7] Bosquet L., Berryman N., Dupuy O., Mekary S., Arvisais D., Bherer L., Mujika I., *Effect of training cessation on muscular performance: A meta-analysis*, Scan J Med Sci Sport, 23:140-149. 2013
- [8] Cohen J., *Statistical power analysis*, Current Direction in Psychological Science, 1:98-101. 1992
- [9] Comeford M.J., Mottram S.L., *Functional Stability re-training: principles and strategies for managing mechanical dysfunction*, Man. Ther., 6:15-26. 2001
- [10] Crisco J.J., Panjabi M.M., *The intersegmental and multisegmental muscles of the lumbar spine. A biomechanical model comparing lateral stabilizing potential*, Spine, 16:793-799. 1991
- [11] Dimkpa U. *Post-Exercise heart rate recovery: an index of cardiovascular fitness*, J Exe Physiol. 12:19-22. 2009.
- [12] Faina M., Mirri G., Manili U., Cavalazzi E., Morandini C., Besi M., Bali F., Manno R., *Effetti fisiologici e psicologici di un programma di attività fisica in un gruppo di anziani non sportivi*, Medicina dello Sport, 61:121-138. 2008
- [13] Ferrari CKB. *Metabolic syndrome and obesity: epidemiology and prevention by physical activity and exercise*, J Exerc Sci Fit., 62:87-96. 2008
- [14] Granacher U., Gollhofer A., Hortobagyi, T., Kressig R.W., Muehlbauer T., *The importance of trunk muscle strength for balance, functional performance, and fall prevention in seniors: a systematic review*, Sports Med, 43:627-641. 2013
- [15] Granacher U., Muehlbauer T., Zahner L., Gollhofer A., Kressig R.W., *Comparison of traditional and recent approaches in the promotion of balance and strength in older adults*, Sport Med., 41:377-400. 2011
- [16] Hibbs A.E., Thompson K.G., French D., Wrigley A., Spears I., *Optimizing performance by improving Core Stability and Core Strength*, Sport Med., 38:995-1008. 2008
- [17] Hicks G.E., Simonsick E.M., Harris T.B., Newmann A.B., Weiner D.K., Nevitt M.A., Tyllavsky F.A., *Trunk muscle composition as a predictor of reduced functional capacity in the health, aging and body composition*

- study: the moderating role of back pain, *J. Gerontol. A Biol. Sci. Med. Sci.*, 60:1420-1424. 2005
- [18] Hodges P.W., *Core Stability exercise in chronic low back pain*, *Orthop. Clin. N. Am.*, 34:245-254. 2003
- [19] Hodges P.W., Eriksson A.E., Shirley D., Gandevia S.C., *Intra-abdominal pressure increases stiffness of the lumbar spine*, *J Biomechanics*, 38:1873-1880. 2005
- [20] Hodges P.W., Richardson C.A., *Altered trunk muscle recruitment in people with low back pain with upper limb movement at different speed*, *Arch Phys Med Rehabil*, 80:1005-1012. 1999
- [21] Hodges P.W., Richardson C.A., *Contraction of the abdominal muscle associated with movement of the lower limb*, *Phys Ther*, 77:132-144, 1997
- [22] Hodges P.W., Richardson C.A., *Inefficient muscular stabilization of the lumbar spine associated with low back pain: a motor control evaluation of transversus abdominis*, *Spine*, 21:2640-2650. 1996
- [23] Hosseini S.S., Asl A.K., Rostamkhany H., *The effect of strength and core stabilization training on physical fitness factors among elderly people*, *World Appl. Sci. J.*, 16:479-484. 2012
- [24] Javadian Y., Akbari M., Talebi G., Taghipour-Darzi M., Janmohammadi N., *Influence of core stability exercise on lumbar vertebral instability in patients presented with chronic low back pain: A randomized clinical trial*, *Caspian J. Intern. Med.*, 6:98-102. 2015
- [25] Jemmett R.S., *Rehabilitation of lumbar multifidus dysfunction in low back pain: strengthening versus a motor re-education model*, *Br J Sports Med*, 37: 91-94. 2003
- [26] Kahle N, Tevald M.A., *Core muscle strengthening improves balance performance in community-dwelling older adults: a pilot study*, *J Aging Phys Act*, 22:65-73. 2014
- [27] Kang K.Y., Choi J.H., Lee S.B., *Effect of core strengthening exercise programs on symmetric double limb support and balance ability in the elderly*, *J IntAcad Phys Ther Res*, 3:378-382. 2012
- [28] Kang K.Y., *Effects of core muscle stability training on the weight distribution and stability of the elderly*, *J. Phys. Ther. Sci.*, 27:3163-3165. 2015
- [29] Kasukawa Y., Miyakoshi N., Hongo M., Ishikawa Y., Noguchi H., Kamo K., Sasaki H., Murata K., Shimada Y., *Relationships between falls, spinal curvature, spinal mobility and back extensor strength in elderly people*, *J Bone Miner Metab*, 28:82-87. 2010
- [30] Katzman W.B., Sellmeyer D.E., Stewart A.L., Wanek L., Hamel K.A., *Changes in flexed posture, musculoskeletal impairments, and physical performance after group exercise in community-dwelling older women*, *Arch Phys Med Rehabil*, 88:192-199. 2007
- [31] Kemi OJ, Wisloff U. *High-intensity aerobic exercise training improves the heart in health and disease*, *JCardiopulmRehabil Prev.*, 30:2-11. 2010.
- [32] Kliziené I., Sipavicienė S., Imbrasienė D., Klizas S., Inokaitis H., *Effect of Core Stability exercise on cross-sectional area of lumbar multifidus muscle and physical capacity*, *J Back MusculoskeletRehabil*, 28:841-847. 2015
- [33] Ko D.S., Jung D.I., Jeong M.A., *Analysis of Core Stability Exercise Effect on the Physical and Psychological Function of Elderly Women Vulnerable to Falls during Obstacle Negotiation*, *J Phys TherSci*, 26:1697-1700. 2014
- [34] McGill S.M., Grenier S., Kavcic N., Cholewicki J., *Coordination of muscle activity to assure stability of the lumbar spine*, *J Electromyography and Kinesiology*, 13:353-359. 2003
- [35] McGill S.M., *Low Back Stability: From Formal Description to Issues for performance and rehabilitation*, *Exerc Sport Sci Rev*, 29:26-31. 2001
- [36] Nichols J.F., Medina D., Dean E., *Effects of strength, balance, and trunk stabilization training on measures of functional fitness in older adults*, *Am J Med Sports*, 3:279-285. 2001
- [37] Nourbakhsh M.R., Arab A.M., *Relationship between mechanical factors and incidence of low back pain*, *J Orthop Sports Phys Ther*, 32:447-460. 2002
- [38] Panjabi M.M., *The stabilizing system of the spine. Part I: function, dysfunction, adaptation and enhancement*, *J Spinal Disorders*, 5:383-389. 1992
- [39] Petersen C., Nittinger N., *Core Stability: Connecting lower core and legs*, *ITF Coaching and Sport Science Review*, 64:18-20. 2014
- [40] Petrofsky J.S., Cuneo M., Dial R., Pawley A.K., Hill J., *Core strengthening and balance in the geriatric population*, *J Appl Res*, 5:423-433. 2005
- [41] Pfeifer M., Begerow B., Minne H.W., Schlotthauer T., Pospeschill M., Scholz M., Lazarescu A.D., Pollähne W., *Vitamin D status, trunk muscle strength, body sway, falls, and fractures among 237 postmenopausal women with osteoporosis*, *ExpClinEndocrinol Diabetes*, 109:87-92. 2001
- [42] Rikli R.E., Jones C.J., *Functional fitness normative scores for community-residing older adults, aged 60-94*, *J Aging & Phys Act*, 7: 162-181. 1999
- [43] Rosa R., Cofano G., Uzzi F., Sannicandro I., *Effect of a core stability training on motor abilities in a group of seniors*, *Sport Sci Health, Suppl 1*:46. 2016
- [44] Sannicandro I., *Attività motorie per i senior*, *Corriere, Milano*. 2013
- [45] Sannicandro I., Colella D., Rosa R.A., Manno R., *Modulation of motor load in adult and old people: effects of different protocol trainings of power values and flexibility*, *Med Sport*, 61:443-454. 2008
- [46] Sannicandro I., *L'allenamento del Core nella prevenzione e nella performance*, *NonSoloFitness, Bologna*. 2014
- [47] Scurati R, Benedini S, Michielon G, Invernizzi PL, Zannini L, Alberti G., *Controlled intensity aerobic activity in water and in the gym: effects on mood and physical efficiency in third age women*. *Med Sport*, 69:215-227. 2016
- [48] Seo B.D., Yun Y.D., Kim H.R., *Effect of 12-week swissball exercise program on physical fitness and balance ability of elderly women*, *J Phys TherSci*, 24:11-15. 2012
- [49] Sinaki M., Brey R.H., Hughes C.A., Larson D.R., Kaufman K.R., *Significant reduction in risk of falls and back pain in osteoporotic-kyphotic women through a Spinal Proprioceptive Extension Exercise Dynamic (SPEED) program*, *Mayo Clin Proc*, 80:849-855. 2005
- [50] Springer B.A., Marin R., Cyhan T., Roberts H., Gill N.W., *Normative values for the unipedal stance test*

with eyes open and closed, J Geriatric Phys Ther, 30:8-15. 2007

- [51] Suri P., Kiely D.K., Leveille S.G., Frontera W., Bean J.F., *Trunk muscle attributes are associated with balance and mobility in older adults: a pilot study*, PM & R, 1:916-924. 2009
- [52] Urquhart D.M., Hodges P.W., *Differential activity of regions of transverses abdominis during trunk rotation*, Eur Spine J, 4:393-400. 2005
- [53] Willson J.D., Dougherty C.P., Ireland M.L., Davis I.M., *Core Stability and its relationship to lower extremity function and injury*, J Am AcadOrthoSurg, 13:316-325. 2005